Do Shotguns and Muzzleloaders Pose Less Risk than Centerfire Rifles for Hunting Deer in Pennsylvania?

MountainTop
Technologies, Inc.

Todd S. Bacastow, Ph.D.

Quiz

True or False: "There is no way a 12 ga slug can travel one mile when fired level at [3 feet]."

Logic

- The amount of time it takes a slug to hit the ground while in flight is the same as one dropping from the tip of the barrel which is .433 seconds (t = SQRT(2x/g)) at 3 feet.
- A bullet must be airborne 3.07 seconds to travel 1 mile at a velocity of 1700 fps.

True or False: "It wouldn't surprise me at all if Sarah Brady [Brady Center to Prevent Gun Violence] herself paid this Todd Bacastow."

An Incident – An Implication

Casey Burns Survived a Stray Bullet While Pregnant

THE EXPRESS-TIMES

Home | Subscribe | 14-Day Archives (Free) | Long-Term Archives (Paid)

Mom and daughter vow to keep up fight

Thursday, October 26, 206

By JIM DEEGAN
The Express-Times

A report that finds hunting with shotguns isn't any safer than hunting with high-powered rifles won't signal the end of a campaign to expand hunting restrictions into parts of Lehigh and Northampton counties, a leading advocate said Wednesday.

Allie Dickinson, whose 18-year-old daughter Casey Kantner was shot in the head by a hunter's stray bullet in 2004, said Pennsylvania hunting rules haven't kept pace with the growth in areas such as the Lehigh Valley.

Conventional Wisdom: Shotguns as a Safety Mgt Tool

SPECIAL REGULATIONS AREAS

Special Regulations Areas include: In western Pennsylvania, all of Allegheny County. In southeastern Pennsylvania, all of Bucks, Chester, Delaware, Montgomery and Philadelphia counties.

Deer: All Special Regulations Area counties are now contained within the Wildlife Management Unit system. Seasons and antler restriction requirements are based on the WMU [illegible] general deer seasons. However, certain laws and regulations in regard to arms and ammunition still apply to specific counties in Special Regulations Areas. It is now lawful to hunt or take deer on private land in the southeast special regulations areas through the use of or taking advantage of bait (see baiting section on General Hunting Regulations page elsewhere in this Digest for more information).

Arms & Ammunition: Muzzleloading long guns [illegible] caliber or larger, bows and arrows, manual or autoloading shotguns [illegible] or larger using slugs and 20-gauge or larger using buckshot. Buckshot is not permitted in Allegheny County. Only bows and arrows, including crossbows, are permitted in Philadelphia County. Crossbows may be used during any firearm deer season statewide, and during any established deer season in Wildlife Management Units 2B, 5C and 5D. In WMUs 2B, 5C and 5D, hunters using a crossbow during the archery seasons must purchase an archery license in addition to their general hunting license and appropriate WMU antlerless deer license. Hunters using crossbows during the muzzleloader seasons must have a muzzleloader stamp in addition to their general hunting license and appropriate WMU antlerless deer license. Crossbows must have a minimum draw weight of [illegible] pounds and a maximum draw weight not to exceed 20[illegible] pounds.

Small Game, Huntable Furbearers & Crows: Manually operated or autoloading shotguns plugged to a 3-shell capacity, manually operated .22 caliber or less rimfire rifles and handguns, and bows and arrows.

Lawful While Trapping: Manually operated .22 caliber or less rimfire rifles and handguns, except as noted under specific Furbearing regulations elsewhere in the Digest.

PGC, 2007 - 2008 Hunting Digest

Incidents

464 incidents, 98 incidents not associated with hunting deer; of the 366 remaining incidents:

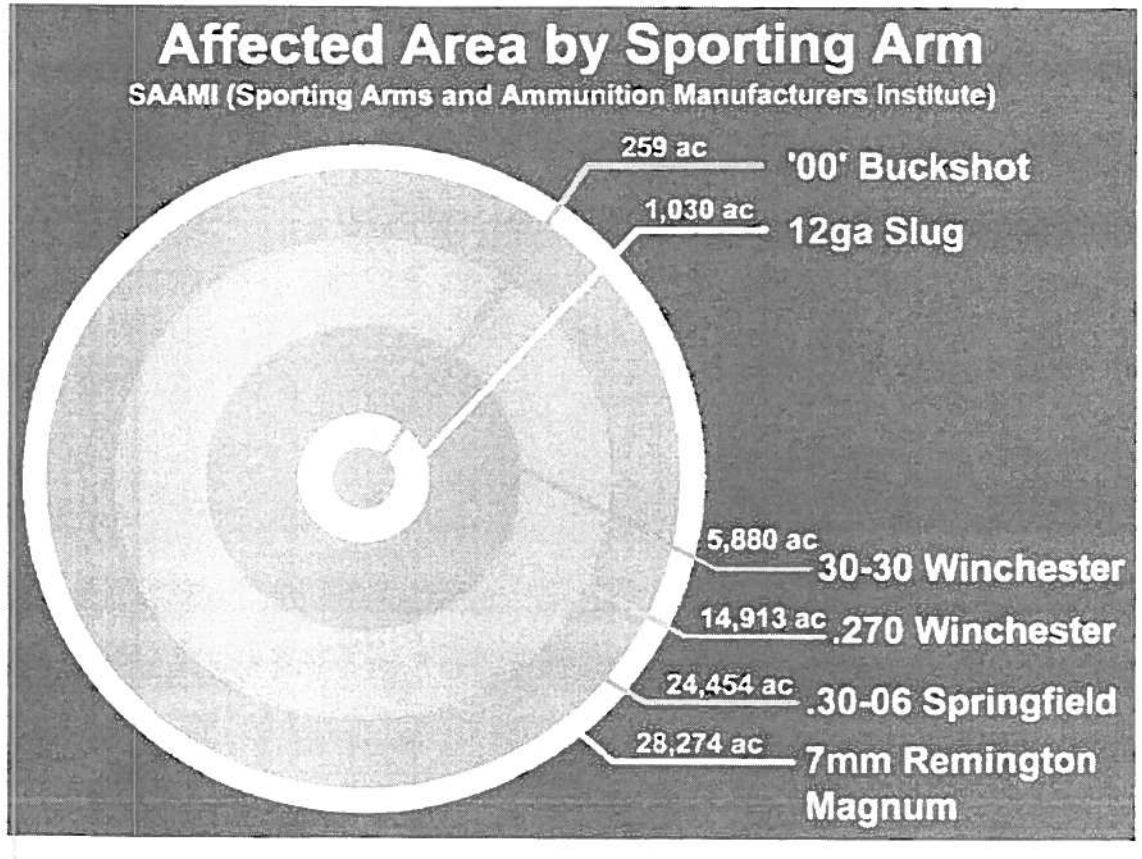
- No rifle incidents in Special Regulations Areas
- 19% of the incidents occurred in Special Regulations Areas
- 75% of the incidents involved rifles
- 21% of the incidents involved shotguns
- 4% of the incidents involved muzzleloaders

Study's Purpose and Objective

Purpose: To answer the question "Do shotguns and muzzleloaders pose less risk than centerfire rifles for hunting deer in Pennsylvania?"

Objective: To provide a scientific basis for policy pertaining to the mandatory use of shotguns and muzzleloaders for deer hunting in designated areas of Pennsylvania.

Maximum Range as Represented in the 1998 Report



Important Assumptions

The average hunter exercises reasonable care

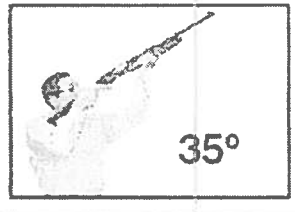
Hunters will tend to use the best available legal firearm-ammunition combination

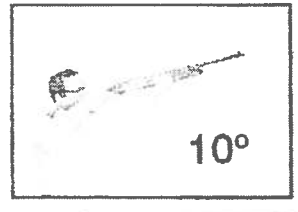
The typical hunter will discharge the firearm at a height of 3 feet to impact a standing deer at approximately 3 feet height

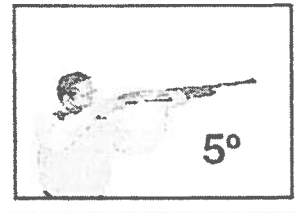
The projectile's trajectory will most frequently be approximately level with the earth's surface

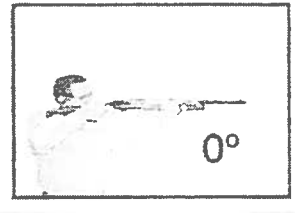
Firing Conditions (Errors)

Firing Condition (Errors)



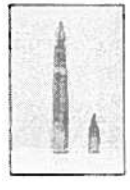




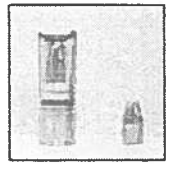


Firing elevation simulated (d)	Firing condition	Feet above a standing deer at 300 feet
35	Errant Shot	210 ft.
10	High Error in aiming	53 ft.
5	Moderate error in aiming	26 ft.
~0	Aiming at target	0 ft.

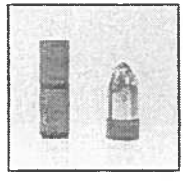
Rifle Firearm-Ammunition



30-06 Springfield soft point
Mass = 150 grains. MV = 2910 fps



12 gauge sabot .50 caliber HP semi-spitzer
Mass = 385 grains. MV = 1900 fps

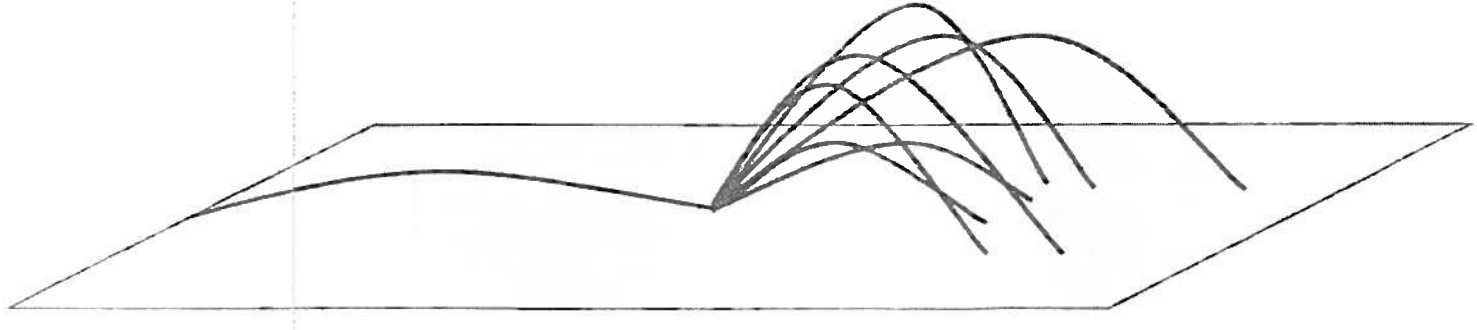


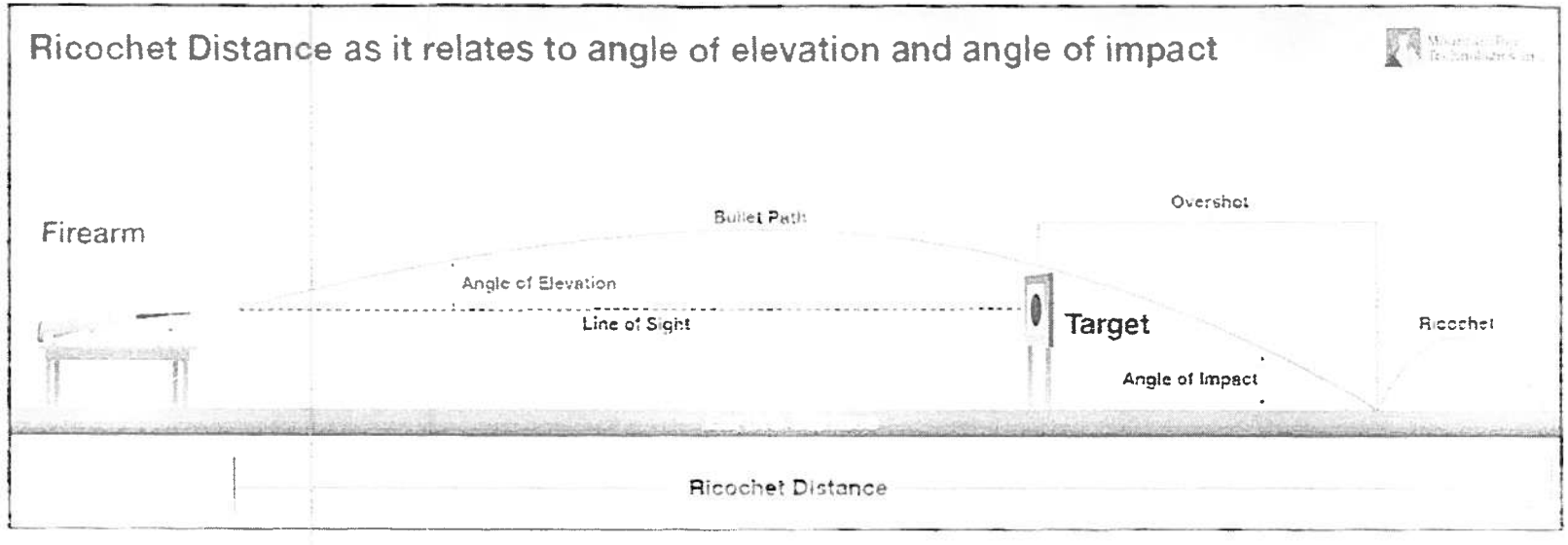
.50 caliber CVA Powerbelt
Mass = 348 grains. MV = 1595 fps

Ricochet Distance

Initial trajectories and ricochet trajectories were computed Armaments Engineering and Technology Center (AETC), Picatinny Arsenal, NJ

Maximum ricochet distances (initial + ricochet) were compared

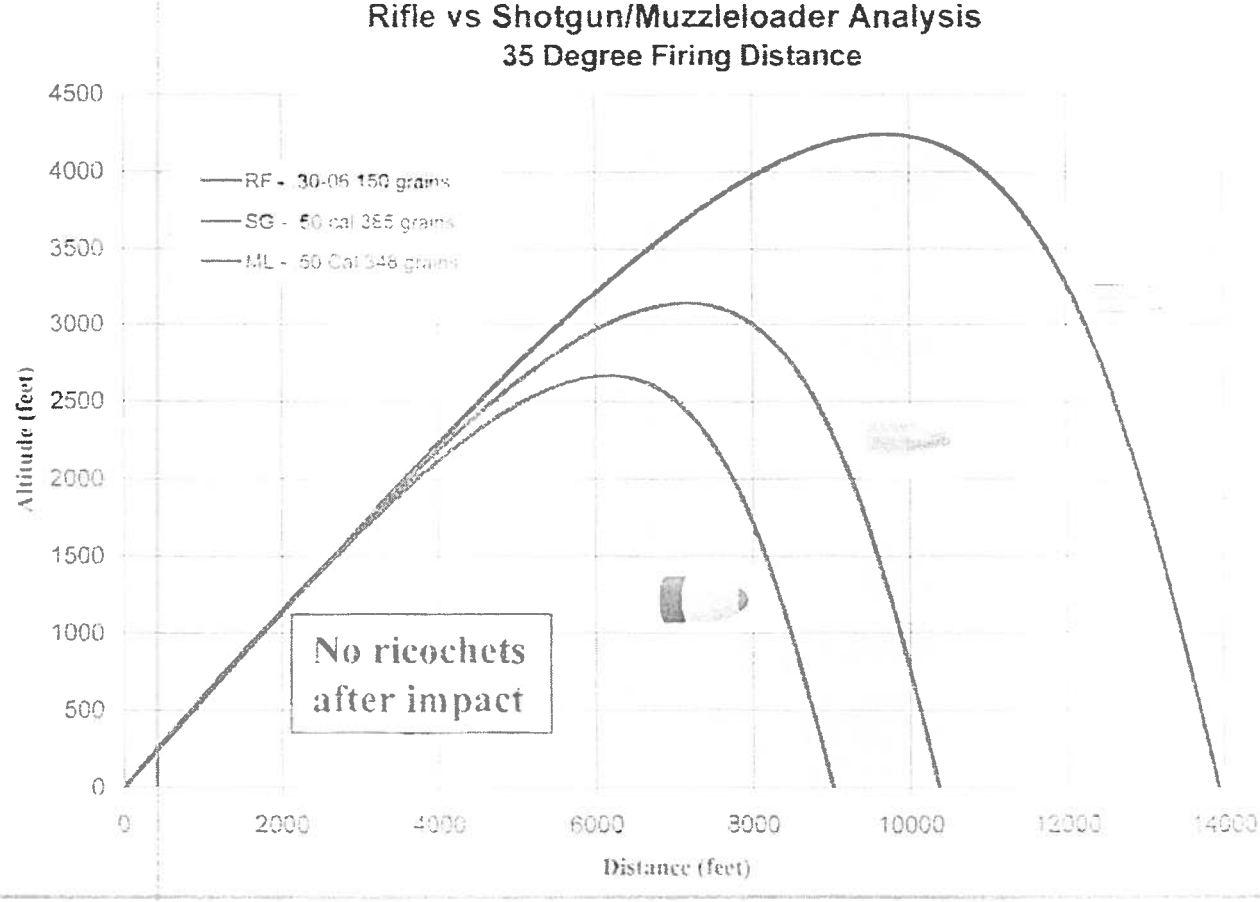




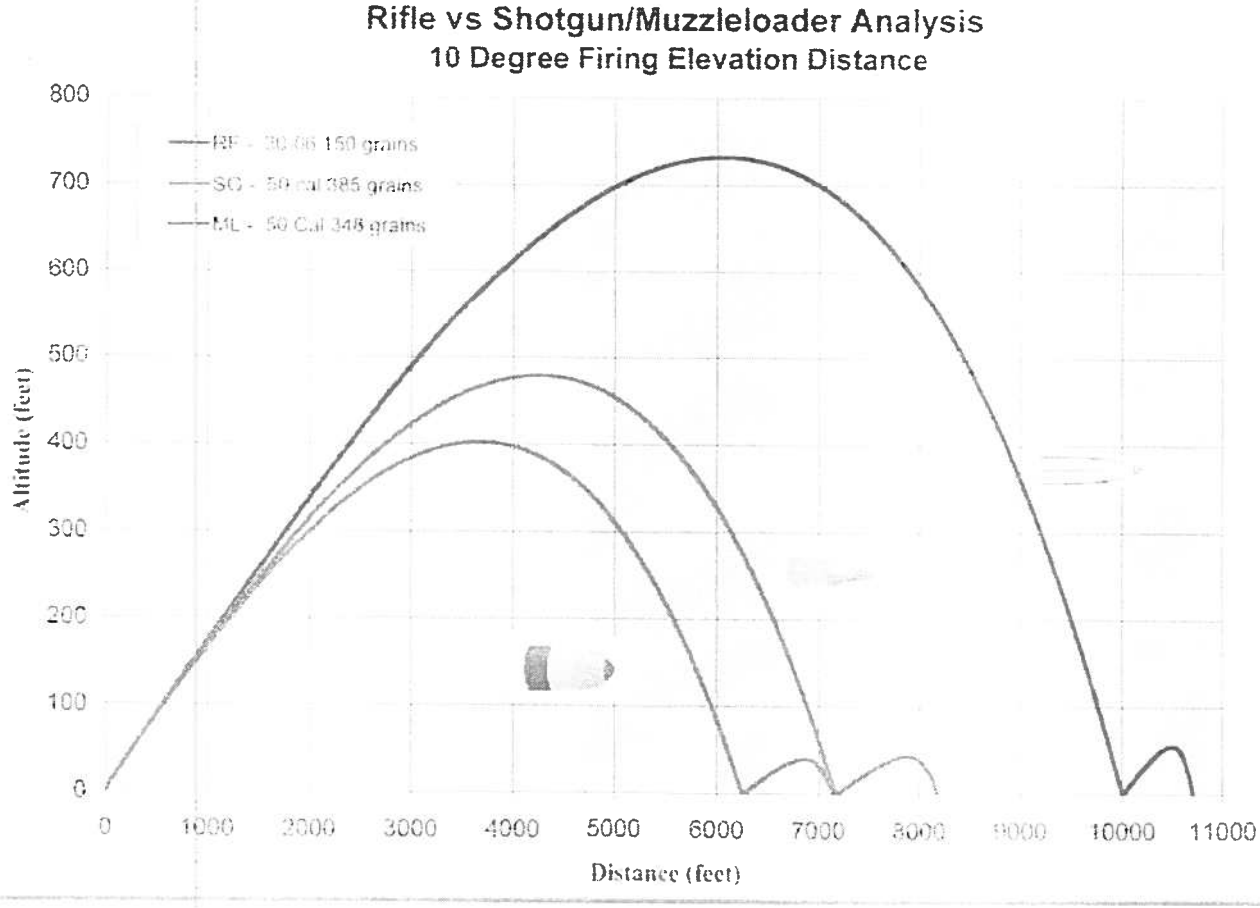
Firing Angle of Elevation & Probability of Ricochet

Firing Angle of Elevation (d)	Probability of Ricochet	
	.30-06	Shotgun/ Muzzleloader
35	0%	0%
10	<.6%	<7.3%
5	<38.0%	91%
0	100%	100%

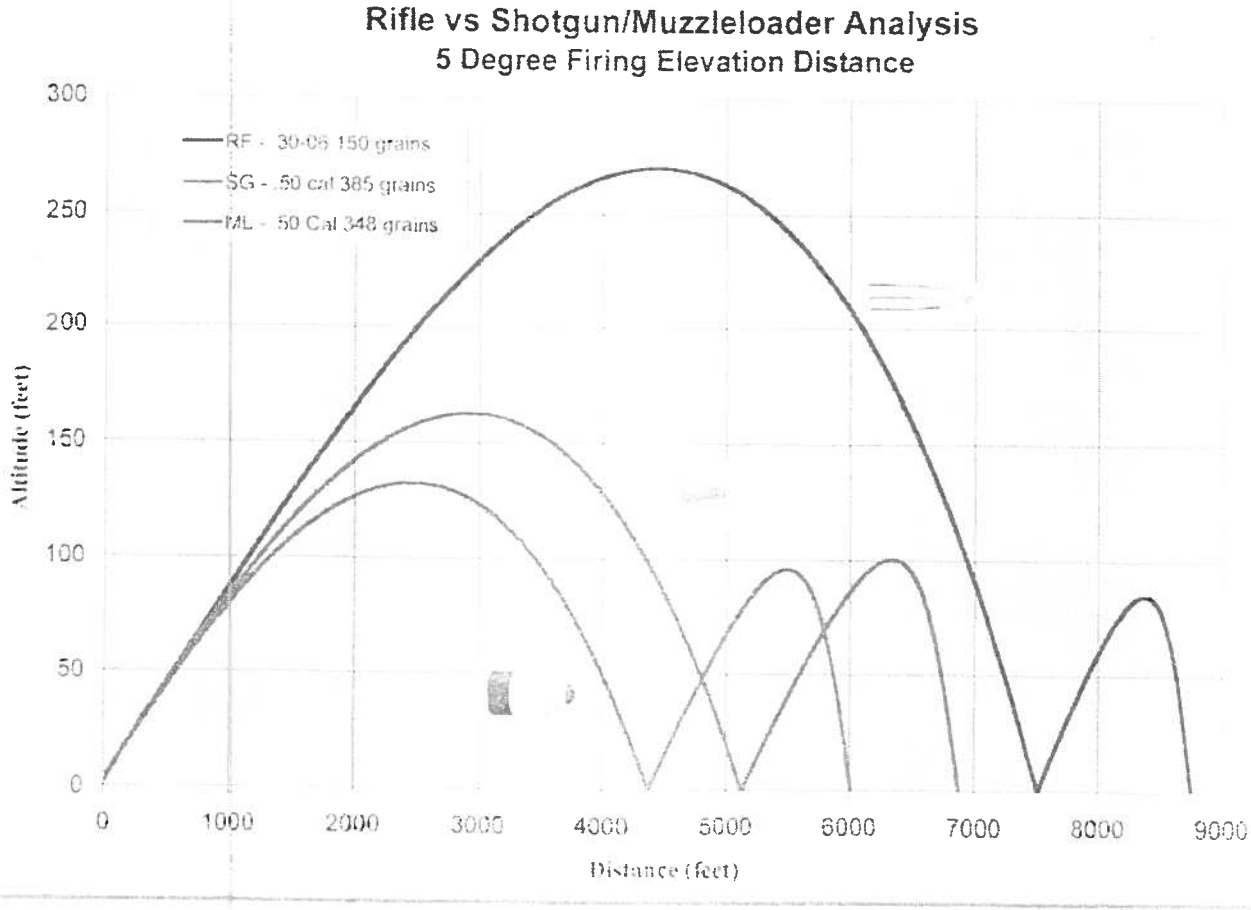
Trajectories for 35° Firing Elevation



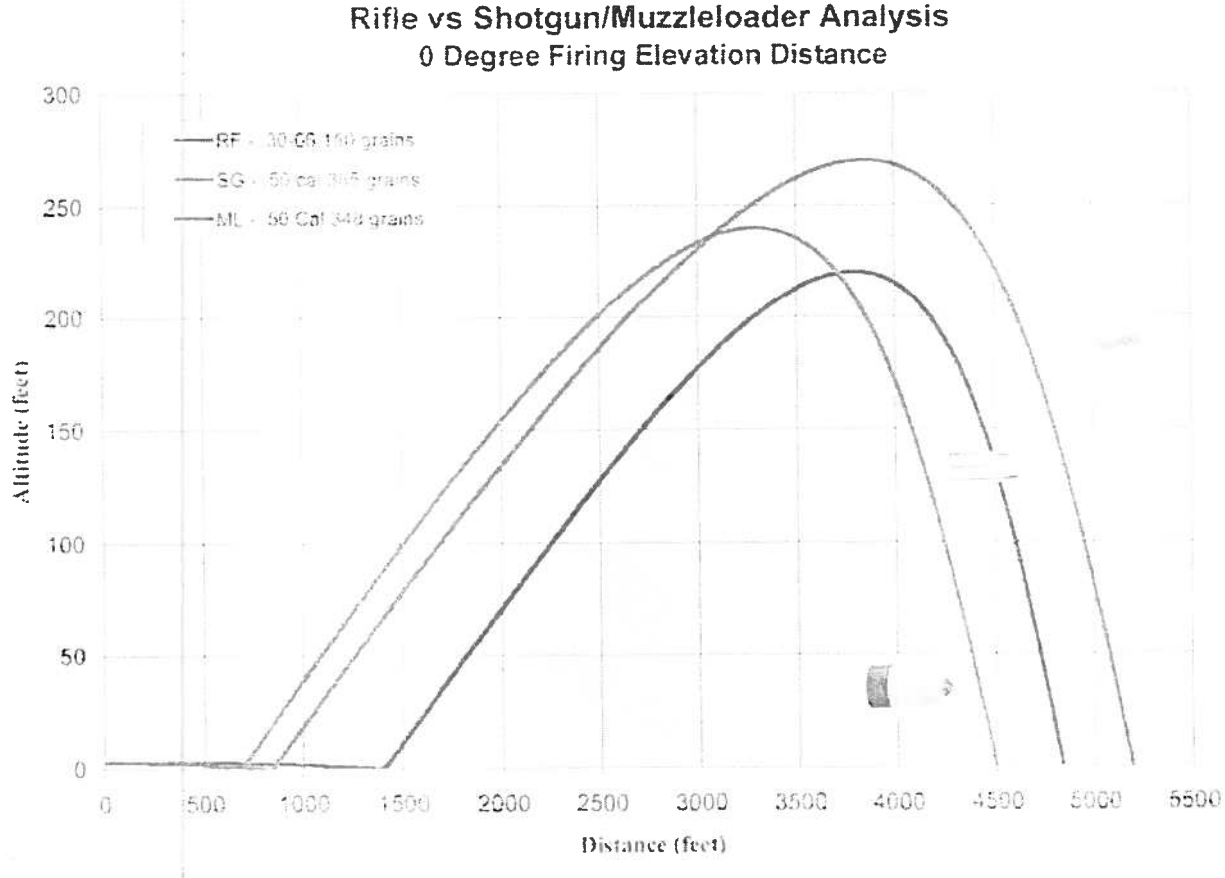
Trajectories for 10° Firing Elevation



Trajectories for 5° Firing Elevation

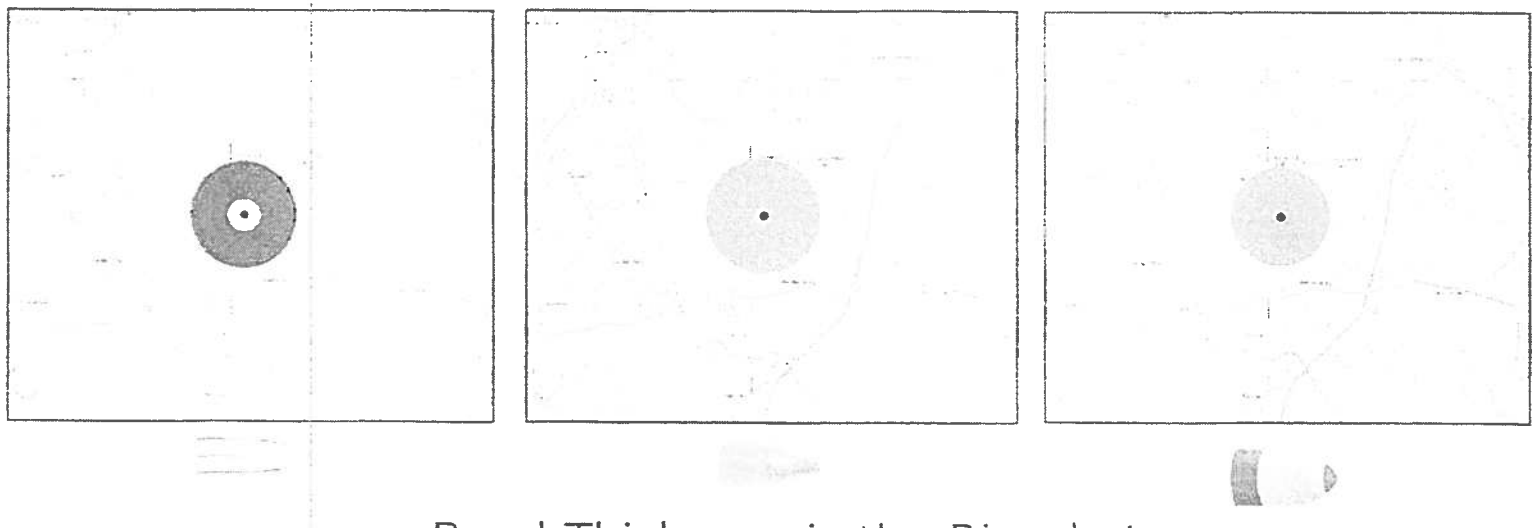


Trajectories for 0° Firing Elevation



0° Elevation with Ricochet

Ammunition	Firing Elevation at ~0 degrees				
	Initial Impact Distance (ft)	Ricochet Distance (ft)	Difference Distance (ft)	% Less than Rifle	
Rifle (.30-06 150 grains)	1408	4835	3427	Initial	Ricochet
Shotgun (.50 cal 385 grains)	840	5205	4365	40%	-8%
Muzzleloader (.50 cal 348 grains)	686	4498	3812	51%	7%



Band Thickness is the Ricochet

Affected Area as a Percent of the Rifle Danger Area

Firearm-Ammunition Combination	Percent of Rifle Danger Area			
	35 deg. Firing Elevation	10 deg. Firing Elevation	5 deg. Firing Elevation	~0 deg. Firing Elevation
Rifle (.30-06 150 grain)	100.0%	100.0%	100.0%	100.0%
Shotgun (.50 cal 385 grain)	55.5%	57.4%	61.7%	115.9%
Muzzleloader (.50 cal 348 grain)	43.6%	44.7%	47.3%	86.5%

Conclusions

Conventional wisdom is sometimes wrong

When considering extreme, high, and moderate firing errors the shotgun and muzzleloader were less risky than the centerfire rifle

When firing with smaller or no aiming error, which is probably the most likely circumstance, the shotgun proved to be riskier than a centerfire rifle

The muzzleloader was always less risky than both the rifle and shotgun

Eliminating or controlling the ricochet seems essential if the shotgun is to be used as an effective risk management option

Answers to the Quiz

False: "There is no way a 12 ga slug can travel one mile when fired level at [3 feet]."

The blogger did not account for the projectile retaining 95% of its energy and excellent ballistic characteristics after initially hitting the ground

False: "It wouldn't surprise me at all if Sarah Brady herself paid this Todd Bacastow."

The study was funded by the PA Legislature and completed in cooperation with the PA Game Commission

As a firearms owner, I'm concerned by a policy that can in some circumstances achieve the opposite of the intended result

May 13, 2012

Comments provided by:
Craig R. Larson (bill author)
30350 Lloyd Lane
Niles, MI 49120

My name is Craig R. Larson, reside in Niles, MI. My occupation is Director of Health, Safety and Environmental for a global company in North America. Unfortunately my occupation requires that I be out of town during this hearing, otherwise I would have attended this proceeding to discuss this proposal.

I am submitting the following comments for HB5416: "Pistol calibers in rifles in shotgun zones".
I have involved with hunter safety for over 30 years in varying activities. I was one of the first Bow Hunter Educational instructors in New York in mid-70's and have participated in firearm safety for similar time period. I have reloaded for firearms for rifle, handgun and shotgun for over 35 years and understand firearm ballistics and performance.

The current MI firearm requirements for shotgun are:
All Firearm Deer Seasons - Shotgun Zone
In the shotgun zone, all hunters afield from November 15-30, and all deer hunters in this zone during other deer seasons, must abide by the following firearm restrictions or use a bow and arrow.

Legal firearms are as follows:

A shotgun may have a smooth or rifled barrel and may be of any gauge.
A muzzleloading rifle or black powder handgun must be loaded with black powder or a commercially manufactured black powder substitute.

A conventional (smokeless powder) handgun must be .35 caliber or larger and loaded with straight-walled cartridges and may be single- or multiple-shot but cannot exceed a maximum capacity of nine rounds in the barrel and magazine combined.

Exception: See Muzzleloading Deer Seasons above for restrictions during this season. From Nov. 15-30, .22 caliber or smaller rimfire rifles and handguns may be used to kill raccoon while hunting raccoons with dogs between the hours of 7 p.m. and 6 a.m.

Precedence Statement: *Indiana recently allowed the use of handgun calibers in rifles: Rifles with pistol cartridges that fire a bullet of .357-inch diameter or larger; have a minimum case length of 1.16 inches; and have a maximum case length of 1.625 inches are legal to use only during the deer firearms season. Some cartridges legal for deer hunting include the 357 Magnum, 38-40 Winchester, 41 Magnum, 41 Special, 44 Magnum, 44 Special, 44-40 Winchester, 45 Colt, 454 Casull, 475 Linebaugh, 480 Ruger, 50 Action Express, and 500 S&W.*

http://www.in.gov/dnr_old/fishwild/huntguide1/0708_HG/0708_hg_generalinfo.pdf

Michigan proposal HB5416:
The proposed rule for MI is similar but restricts the pistol calibers as straight wall and must be the same calibers already allowed in pistol configuration to be used in rifle configuration.

Some of the benefits for the rule change are as follows:

1. *New hunter recruitment as well as keeping older hunters active - This proposed rule will provide maximum opportunity for all ages of deer hunters; young and old to enjoy deer hunting. Hunter participation is declining for a variety of reasons and this bill will help bring in hunters otherwise may not have participated in deer hunting due to the difficulty in shooting high recoil slug shotguns. Typically a 20 gauge slug shotgun would be the option for most slight build deer hunters which still results in significant and unpleasant recoil to slight build shooters. This recoil is detrimental to these groups of individuals from participating in deer hunting and clearly affects their ability to be accurate with a firearm that has significant recoil. The size of a rifle, balance, recoil, weight, and other factors provide an ideal hunting weapon for young, light framed, and smaller stature hunters.*

2. *Safety – The proposed rule allows the same pistol cartridges currently legal in the State of MI for deer hunting to be allowed in rifle configuration. The performance of a pistol caliber in a rifle will not significantly change the ballistics of the pistol calibers already allowed in MI. Best performance example of a pistol caliber would be in a single shot Thompson Contender with 14" barrel. The velocity difference between such pistol and rifle is not significant nor would it significantly exceed current firearms allowed in MI for deer hunting such as a muzzleloader or shotgun with sabot bullet ammunition. This is principally due to the powder burn rates in pistols is of a powder burn rate of fast designation which does not translate to significant gain in velocity in rifles. This is due to the powder being immediately consumed to maximize performance in short barrel pistols. You cannot change the pistol powder due to higher pressures that rifle powders would deliver in a pistol brass configuration.*

   The state of Pennsylvania published a report on March 2007 titled " Do Shotguns and Muzzleloaders Pose Less Risk Than Center Fire Rifles for Deer Hunting in Pennsylvania" that studied the safety of rifles versus shotgun and muzzleloader. Pennsylvania retained Mountain Top Technologies to perform this study. I have included a presentation from Mountain Top Technologies by Todd S. Bacastow, PhD which was part of the Pennsylvania study on safety of firearms which studies the safety of rifles versus shotguns and muzzleloaders.

   The following excerpted Purpose and Conclusion of the report is provided below and full report can be downloaded from the Pennsylvania Department of Natural Resources website at: http://lbfc.legis.state.pa.us/ *; Under the Contents Section, select Reports Released, scroll down to Game and Fisheries section and select stated report. Unfortunately, there is not a direct link to this report.*

   Pennsylvania Study "Do Shotguns and Muzzleloaders Pose Less Risk Than Center Fire Rifles for Deer Hunting in Pennsylvania"

   2.1 Purpose and Objective

   The purpose of this report is to examine if shotguns and muzzleloaders are less risky than centerfire rifles when used for hunting deer in Pennsylvania. As such, this report only addresses one question inherent in HR61. This question is: do shotguns and muzzleloaders pose less risk than centerfire rifles for hunting deer in Pennsylvania?

   The objective of this study is to provide a scientific basis for policy pertaining to the mandatory use of shotguns and muzzleloaders for deer hunting in designated areas of Pennsylvania. The technique utilized to determine risk in the 1998 study conducted by the PGC was to compare the circular area around the hunter based on the firearm characteristics. This study assumes a similar definition of risk and compares the danger areas of firearm-ammunition combinations and representative cases of error when a round is discharged.

1.5 Conclusion

1.5.1 Summary Statement

Conventional wisdom holds that shotguns are inherently less risky than rifles when hunting deer. This is evidenced by the fact that the PGC as well as other states have established shotgun only hunting areas. This study, however, has concluded that this is not always the case.

Stated in a few words, when considering extreme, high, and moderate firing errors (35, 10 and 5 degrees firing elevations), shotguns and muzzleloaders are less risky than the centerfire rifle. When firing with smaller or no aiming error (approximately 0-degrees firing elevation), a shotgun proved to be riskier than a centerfire rifle. The muzzleloader was always less risky than both the rifle and shotgun. Eliminating or controlling the ricochet seems essential if the shotgun is to be used as an effective risk management option. If ricochets could be controlled, then the shotgun and muzzleloader would be less risky in all cases.

1.5.2 Discussion

The study concludes that comparing risk using only the maximum range obtained at a 35-degree firing elevation and the corresponding danger area of the firearm ammunition combination provides the policy maker an incomplete picture. When discharging the examined firearm-ammunition combinations with large (10-degree)and moderate (5-degree) aiming errors, the danger areas of the shotgun and muzzleloader are less than that of the rifle; hence, given this firing condition, the shotgun and muzzleloader are less risky than the rifle. However, shotguns firing modern saboted ammunition has a larger danger area than the .30-06 rifle when the angle of elevation is approximately level (0-degrees); hence, given this firing condition, the shotgun is riskier than the rifle. In other words, the typical hunter discharging a 12 gauge shotgun fitted with a rifled barrel firing a .50-caliber saboted slug at a deer on level terrain is riskier than a hunter firing a .30-06 with a 150 grain expanding bullet at the same deer. The muzzleloader proved to have less risk in all firing conditions.

The explanation for the last case where the shotgun is more risky relates to how the .30-caliber projectile interacts with the impact media at shallow (low) angles and its aerodynamic characteristics after ricochet. The smaller cross sectional area of the .30-caliber projectile and its shape contributes to a higher loss of energy on impact and after ricochet the .30-caliber bullet tends to tumble in flight with a high drag. Test data confirm that the .50-caliber projectile's larger cross sectional area and its shape contribute to less energy loss on shallow angles of impact and after ricochet the projectile exhibits less drag which results in a greater total distance traveled.

The basic premise one can take from this report is under normal hunting conditions where a hunter is aiming at a deer vital region (approximately 2 feet off the ground); a center fire rifle is no less safe than a shotgun or a muzzleloader. Furthermore, HB-54516 provides for additional safety by limiting the rifle configuration to pistol calibers which further enhances the safety of centerfire rifle configuration in shotgun zones.

3. *Accuracy - Rifles are clearly and without doubt inherently more accurate than shotguns which will result in a more efficient deer kills. If one were to take into consideration the reduced recoil for slight build deer hunters, increased practice at the rifle range resulting in better proficiency there will less likelihood of injured deer from hunters that may be recoil sensitive thus, not as accurate with their weapons.*

4. *Economical - Many hunters are financially unable to become fully proficient with their firearms due to the high cost of shotgun slug ammunition when a box of shotgun sabots cost $12-18 a box of five (5) shotgun sabots on average or approximately $2.50 to $3.50 a shot. Pistol caliber ammunition is significantly cheaper which will allow more range time to become more accurate and proficient with their firearm.*

5. *Federal Aid in Wildlife Restoration Act (i.e. Pittman Robertson) – and other taxes. Sales on rifles shooting pistol cartridges, accessories, ammunition, targets, etc. will provide added revenues in all of these areas. This will result in more revenue being shared back to the State of Michigan. I have spoken to Mr. Kevin Claire Mgr. of Lunkers Sporting Goods in Edwardsburg, MI and he emphatically stated their store would definitely see increase of sales of both ammunition and firearms if this proposed rule were approved. Customers are aware of this proposal and are anxiously waiting for the final approval of this rule. Mr. Claire stated he would be available for discussion upon request.*

In conclusion, I support this rule to be beneficial to the State of Michigan to enhance the deer hunting experience of all age groups affected without increased risks to the public. Although I was not able to attend this hearing, I am willing to discuss this matter at another date if given sufficient notice to do so.

Thank you for the opportunity to submit these comments.

Regards,

Craig R. Larson
Niles, MI